Layer de la Haye WTW, Essex

treatment works upgrade project for Essex & Suffolk Water

by
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Layer de la Haye Water Treatment Works, is located to the south of Colchester and supplies potable water into Essex and NE London, serving a population of approximately 750,000 people. The existing treatment works comprises primary 'roughing' filtration through Boby and Paterson rapid gravity streams, slow sand filtration and final chlorination. This process produces high quality potable water at relatively low unit cost. Despite upgrades in the 1970s and early 2000s, throughput is now close to maximum capacity. Forecast increases in demand led Essex & Sussex Water to investigate various options to increase capacity to meet this need.

Layer de la Haye WTW -Confined connections to existing infrastructure *photo courtesy of Essex & Suffolk Water*

Description of the problem

Continued growth in population within the Essex resource zone, particularly associated with the Thames gateway development, required Essex & Suffolk Water to give due consideration to new water treatment and supply schemes for the future. The company's water resources plan subsequently identified the need to expand the nearby Abberton reservoir and increase output from Layer WTW in-line with the following output forecasts:

145Ml/d (Presently)- 165Ml/d (by 2015) -210Mld (by 2020)

To ensure that these current and future needs could be met, Essex & Suffolk Water investigated a number of options with their framework consultant MWH, Initial studies identified that seasonal algal blooms were restricting output from the works for between 8 -10 weeks per year. Furthermore, the hydraulic profile of the works had reached the limit beyond which higher output flows could not be reliably sustained. Essex & Suffolk Water, therefore, undertook an extensive pilot programme to investigate process performance, and used a comprehensive dynamic hydraulic model in order to identify the flow constraints across the process. Throughout these investigations, the overall cost of treatment was an important consideration in order to preserve the economic advantage of the relatively low-cost existing process.

The adopted solution

Pilot trials concluded that Dissolved Air Floatation DAF was the most effective and robust treatment method for ensuring maximum works throughput during algal bloom periods. However, both the capital and operational costs associated with running a DAF plant and

New treated water pumping station under construction *photo courtesy of Essex & Suffolk Water*

dealing with the associated sludge made the process very expensive, and was not necessary for most of the year. Therefore, this option was not favoured on economic grounds.

The hydraulic modelling of the site also revealed that if overall headloss could be reduced across the site then the existing process would be able to meet the forecast increase in demand for 145Ml/d and even 165Ml/d for the vast majority of the year. Recommendations for tackling the main causes of excessive headloss were put forward for consideration by the internal project stakeholders. The key headloss reduction strategies adopted are summarised below:

1. **SSF Management and Monitoring -** This included a revised programme of frequent filter skimming and media reinstatements to reduce headloss throughout the year, automated monitoring of filter performance to improve process control and better access systems for plant and machinery to speed up filter maintenance cycle times.

2. **Improved Primary Filter controls** - Regulation of filter throughput enabling staff to easily select preferable primary filter streams to minimise blockage during periods of poor raw water quality.

3. **Construction of new Treated Water Pumping Station at lower level -** Designed to meet both short and long term increases in potable water demand, increase available head across the treatment works, improve operational efficiency and reduce carbon emissions.

Trials were undertaken with the new slow sand filter management plan which involved running filters at higher rates for shorter periods than had historically been the case. These changes made overall output flows more predictable. The consultants also developed a process risk model based on the history of raw water quality. It defined the periods in the year when the plant may be unable to produce the required 145Ml/d, and predicted what flows could be reliably expected.. Based on this statistical analysis, a .seasonal risk profile was produced. The key stakeholder to the project ultimately accepted the risk of the predicted output constraints and approved a hydraulic upgrade of the works with associated slow sand filter management plan.

Contracts were awarded to the Essex & Suffolk Water major works framework contractor Carillion, for implementation of those items listed above.

Project delivery

Construction work began in October 2006 with the SFF management and monitoring package. The SSFs were to remain operational throughout the period of construction and therefore close liaison between the construction staff and site operational staff was required to ensure that the construction programme could be met without risk to supply. The delivery of the automated primary filter controls and the new treated water pumping station began in February 2007.

The most substantial element of this work was the construction of the treated water pumping station which was undertaken on an undeveloped area of the treatment works. This new pumping station comprises four pumps configured in a duty, assist, assist, standby arrangement, together with chemical dosing and water quality monitoring equipment, and is capable of producing up to 165Ml/d. The station was also designed to meet the strict requirements for noise and visual impact stipulated by the planning approval. Provision was also made for a fifth pump to be installed at a later date to meet the longer-term flow requirement of 210Ml/d.

Building the interconnecting pipework amongst the existing plant and equipment was a particular challenge on the confined site. Significant surge forces as result of the high delivery pressures and flow rates in the new pipework required substantial thrust restraint structures, further congesting the construction site. The project is currently scheduled for completion in October 2008 after rigorous proving trials are completed.

In summary, the final solution preserves the economic advantages of the existing process, meets the operational risk levels that the business considers acceptable, provides a step towards improved efficiency and carbon impact through the installation of high efficiency pumps, and will support the long term water supply needs of Essex.

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